The Hæmatozoa of Australian Birds.—No. 1.

By J. Burton Cleland, M.D., Ch.M. (Syd.), and T. Harvey Johnston, M.A., B.Sc. (Syd.), Bureau of Microbiology, Sydney.

[Read October 4, 1910.]

Plates XXV. and XXVI.

It is proposed in the following paper, which we hope will form one of a series to be published from time to time, to deal with certain minute parasites found in the blood of Australian birds. In addition to descriptions of various species of these hæmatozoa which we have recently had under examination, we include a summary of the findings of previous workers in Australia in this field, and also give a list of our negative findings, which latter may prove of value in working out the intermediate hosts of some of the parasites, and in establishing the extent of the wanderings of individual birds of a species. It may be added further, that in no instance were the birds ruthlessly slain, but in every case skins were prepared, the body tissues and alimentary tract were searched for helminths, and the stomachs and crops were subjected to careful examination to ascertain the exact nature of the food. The information thus gained will appear, or has appeared, in appropriate quarters. It will thus be seen that every possible available use was made of the specimens secured.

THE HALTERIDIA OF AUSTRALIAN BIRDS.

In continuance of our descriptions of the blood-parasites of Australian birds, we have to record the presence of examples of the hæmosporidian genus *Halteridium* in additional species. Our detailed examination of these parasites from nine different kinds of Australian birds has led us to consider that more than one species of the parasite is present—a view we have given expression to in our earlier papers.(1 and 2) But, though we believe that with more complete studies of the life histories these differences will receive accentuation, we have found it often very difficult to describe such variations as are met with in our specimens in such a way as to differentiate one species

(1) Cleland and Johnston, Jour. Proc. Roy. Soc., N.S.W, xliii., 1909, pp. 75-96.

(2) Johnston and Cleland, Proc. Linn. Soc., N.S.W., xxxiv., 1909, pp. 503-7.

from another (if the differences are of specific rank), and these again from the descriptions of *H. danilewskyi* available to us.[3] This difficulty has been accentuated by reading various recent papers in which the writers describe *H. danilewskyi* as occurring in different birds, and sometimes hint that probably more than one species is incorporated under this name. We see only one way out of this difficulty, and that is to describe as fully as the material available will permit, the various parasites discovered in any particular bird.

Before passing on to describe the additional Halteridia we have found, we may first of all refer to some of the outstanding features of the first five forms we have described, the only Halteridia hitherto, we believe, found in Australian birds: —

H. meliornis (from *Meliornis novæ-hollandiæ*, Lath.) was specially noticeable for the number of small forms, sometimes as many as seven, in one red cell.

H. philemon (from *Tropidorhynchus corniculatus*, Lath., syn. *Philemon corniculatus*, Lath.) showed a protoplasm often highly granular.

H. geocichlæ (from *Oreocichla lunulata*, Lath., syn. *Geocichla lunulata)* presented special appearances in its gametocytes.

H. ptilotis (from *Ptilotis chrysops*, Lath.) did not present any special outstanding features.

H. nettii (from *Nettium castaneum*, Eyton) had remarkably large pigment masses, and was a very large parasite.

All these apparent differences may, it is true, only be stages in the life-history of one species of parasite.

Halteridium, sp. from Pomatorhinus superciliosus (Fam. *Timeliidæ).*

Plate xxv., figs. 1-5.

The bird, the victim of this parasite, was shot at Hallett Cove,[4] near Adelaide, in May, 1910, in company with several other birds which did not show the presence of hæmatozoa. Two further examples of this species of bird, shot at Tailem Bend, in South Australia (about 50 miles from the above locality), were not infected by it. The discovery of hæmatozoa in a South Australian bird is, we believe, now recorded for the first time.

---

[3] Cardamatis (Centr. f. Bakt., Orig., lii., 1909, pp. 351-368) gives a long list of European birds in which this parasite occurs.

[4] In the subcutaneous tissues of this bird a number of larval echinorhynchs were found.

The parasite itself is characterized by the large size of the halter-forms, which frequently occupy four-fifths or five-sixths of the available space in the red cells. It is also remarkable for the large size of the melanin granules in many specimens; these, though sometimes numerous and small, are at others remarkably large, and then appear sometimes as definite rods, sometimes as rounded masses.

The following is a description of ten consecutive parasites, afterwards arranged in order:—

(1). Pale, immature form, occupying only one end and side of the red cell. Melanin as small granules towards each end.

(2). Very pale-coloured. Occupies whole of red cell, except part of one side a little more extensive than length of nucleus. Host's nucleus a little displaced. Groups of large melanin granules at one end; six scattered fairly large granules at other; two near middle.

(3). Almost colourless. Extent and displacement of nucleus as in (2). Finely peppered throughout with rounded small melanin granules, often collected in little groups.

(4). Almost colourless. Extent and displacement of nucleus as in (2) and (3). Melanin as fairly large granules grouped at each end.

(5). Very pale. A little less extensive than (2), etc. Host's nucleus a little displaced. Medium-sized, rod-shaped granules, chiefly towards both ends and outer edge.

(6). Very pale. Extent and displacement as in (5). Pigment large, some masses very large; towards each end.

(7). Very pale. Parasite occupies whole of one end from level of nucleus, one side, and the longitudinal half of the other end. Nucleus not displaced. Pigment at both ends; very large at one end (9 masses), smaller at other (4).

(8). Pale-blue protoplasm. Occupies one side and part of ends. Very coarse large grains of pigment; two masses of several grains at one end, one in the middle, several scattered masses at other end.

(9). Pale-blue. Occupies nearly two-thirds of red cell. Host's nucleus a little displaced. Melanin as very large rod-shaped masses scattered generally.

(10.) Pale-blue. Occupies quite two-thirds of red cell. Nucleus a little displaced. Pigment as small masses in groups, chiefly at one end and middle, with small group at other end.

HALTERIDIUM, sp. from MYIAGRA NITIDA (Fam. *Muscicapidæ*).

Plate xxvi., figs. 1-5.

In an imperfectly-prepared blood-film from the Leaden Flycatcher, *Myiagra nitida*, shot at the Hawkesbury River in November, 1909, Halteridia were detected in the red cells.

The parasites possessed the typical form, and invested the host nucleus very closely, but did not displace it. Their size was about 0·01 mm. by 0·002 mm. They were thus much smaller than those seen in some other birds, *e.g.*, *Zosterops cærulescens*. The pigment was usually aggregated towards one end, but parasites were seen in which it was more dispersed. In all cases there were relatively few granules. No enlargement of the host cell was recognized.

HALTERIDIUM, sp. from an OWL, *Ninox boobook (?)*.

Plate xxvi., figs. 7-15.

In July, 1910, Dr. T. L. Bancroft, of Brisbane, kindly forwarded to us blood-films from an owl shot near Brisbane. These contained in relative abundance a Halteridium which, to our view, seems to differ from the other forms we have met with in Australian birds.

Male and female gametocytes were readily recognizable, and, in the accompanying descriptions of eight consecutive specimens examined, a re-arrangement has been made by which male forms are first taken, and female forms are concluded with: —

(1). Protoplasm pale-blue; nucleus pale-red, elongated; 14 scattered melanin granules.

(2). Parasite more towards one end of host cell; this end of parasite broader, other end narrowed: protoplasm pale-blue; nucleus pale-red, rather concentrated; 11 scattered melanin granules.

(3). Protoplasm pale: nucleus pinkish, elongated; 8 melanin grains towards one end, 1 at other, with another grain nearer centre, 2 opposite nucleus.

(4). Parasite towards one end of host cell: protoplasm pale; nucleus pinkish, elongated: 3 grains of melanin beyond centre at one end, 2 coarser grains towards other end, 2 coarse ones near centre.

(5). Parasite towards one end; nucleus pale-pink, elongated: 6 grains of melanin towards one end, 2 towards other end, 6 coarser ones opposite nucleus along outer edge.

(6). Protoplasm a little deeper blue; nucleus pale-pink, elongated: 2 masses of melanin towards one end, 4 towards other.

(7). Protoplasm like (6); nucleus pale-red, rounder; melanin as mass of several grains at one end, as 4 scattered grains at other, and as 2 scattered ones near nucleus.

(8). Protoplasm deep-blue, vacuolated; nucleus rounded, small, purplish.

HALTERIDIUM, sp. from PTILOTIS PLUMULA, Gould (Fam. *Meliphagidæ*).

Plate xxvi., figs. 16-22.

Halteridia were found in a honey-eater, *Ptilotis plumula*, shot at Perth, Western Australia, in August, 1909. As far as we know, the finding of a blood parasite in native birds from that State is now recorded for the first time. As the various European birds which have been introduced into the Eastern States of Australia (the sparrow, goldfinch, blackbird, starling, thrush, English skylark, etc.) do not so far exist in Western Australia, it shows that Halteridia were present in Australian birds before the introduction of species from elsewhere.

Most of the parasites were immature forms. In the only large halter form met with, the nucleus of the host cell was pushed a little aside. We can detect no definite differences (unless in a smaller amount of pigment) between this parasite and the Halteridium found in *Ptilotis chrysops* in Sydney district, though the two host birds are separated by a distance of about 2,000 miles.

The descriptions of nine successive specimens afterwards arranged in order are as follow:—

Host's red cells, 10·5 μ. × 5·5 μ.; nucleus, 7·2 μ. × 2 μ.

(1). Very minute form; clear; as yet no pigment.

(2). Pale-coloured; 3·6 μ. in size; three small melanin grains.

(3). About same size as (2); at one end of host cell; no pigment.

(4). A little larger; at one end; small granule of melanin.

(5). At one end; 6·3 μ. long; edge of parasite well defined, centre clear, 2 granules in centre.

(6). Half-grown; clear; small pigment granules along side towards host's nucleus and several in middle.

(7). Half-grown; pale; melanin along edge next host's nucleus (? artefact).

(8). Length of host's nucleus, but thinner; well stained; several melanin granules all at one end.

(9). Occupying more than three-fourths of red cell (whole of one side and both ends); nucleus of host pushed a little to one side; stains fairly well, finely granular; its nucleus not stained; melanin as one large and two smaller masses in centre.

HALTERIDIUM, sp. from MELITHREPTUS ATRICAPILLUS, Lath. (Syn. *M. lunulatus*, Shaw), (Fam. *Meliphagidæ*).

Plate xxv., figs. 6-10.

Halteridia were detected in films from a bird shot in the Sydney district in July, 1909. The parasites, though rather large, did not displace the host nucleus. Their protoplasm was very lightly stained, the nucleus when visible being a pale-pink (Giemsa). The latter was either a narrow elongate or a rounded structure, placed medianly or nearly so. Granules were rather small and numerous in the more deeply-staining parasites, while they were fewer and larger in the pale forms.

HALTERIDIUM, sp. from ZOSTEROPS CŒRULESCENS (Fam. *Zosteropidæ*).

Plate xxv., figs. 11-17.

The two birds harbouring this parasite were shot in February and in April, 1910, near Sydney. Blood-films from them were, unfortunately, ill-prepared, so that the structural peculiarities of the parasite were not readily distinguishable. The chief points noticed were its large size, occupying often five-sixths of the available space in the erythrocyte. The host cells themselves often showed definite enlargement with distinct displacement of the nucleus.

THE TRYPANOSOMES OF AUSTRALIAN BIRDS.

TRYPANOSOMA ANELLOBIÆ, n. sp. from ANELLOBIA CHRYSOPTERA, Lath. (Syn. *A. mellivora*, Lath., Fam. *Meliphagidæ*).

Plate xxvi., figs. 6, 11.

We are indebted to Dr. T. L. Bancroft for sending us blood-films from eleven birds belonging to this species shot near Brisbane. In four of these no parasites were detected, in three large microfilariæ were present; in two there were two species of microfilariæ, a small form in addition to the larger *(vide infra)*; while in two others there were two kinds of filarial embryos as well as a few trypanosomes. Dr. Bancroft detected the presence of these hæmatozoa in some of the films before sending them down to us.

The trypanosomes, very few of which were seen, were about 0·035 mm. in length, the maximum breadth being 0·002 mm. Their form was elongate, the middle portion being uniform in breadth, but gradually narrowing anteriorly and posteriorly, each end being pointed. The anterior extremity was longer and narrower than the posterior. The kinetonucleus was situated at 0·003 mm. from the posterior end. The part between this and the end was only slightly stained, whereas the rest of the body was deeply coloured (Giemsa). The nucleus could not be detected. The undulating membrane was extremely narrow, and appeared to be very short. A flagellum was not recognized.

The occurrence of trypanosomes in Australian birds does not seem to have been recorded previously, consequently Dr. Bancroft's discovery is of considerable interest. A typical film has been donated to the Trustees of the Australian Museum, Sydney.

Protozoa (?) present in the blood of Zosterops cœrulescens.

Plate xxv., figs. 18-20.

In a film from one of the specimens of *Zosterops cœrulescens* in which Halteridia were detected, peculiar bodies were present in considerable numbers. Whether these are protozoa or not we are unable to decide. They had a superficial resemblance to the leucocytozoa of birds, but a definite relationship to any of the cells of the blood could not be established, though they were frequently found in close proximity to injured red cells. That they were adventitious bodies, accidentally incorporated in the films when these were made, seems unlikely, as the slide was practically free from extraneous dirt.

The bodies varied considerably in size and appearance, but presented in general an elongated spindle-shape and a deeply-stained blue body (Giemsa's stain). The length was from 0·008 mm. to 0·0133 mm., and the maximum breadth 0·0025 mm. to 0·004 mm. In some cases one end was gradually pointed and the other bluntly truncated. No definite nuclear apparatus was detected, but in all large, rounded, deep-blue granules were present. Sometimes a dozen or so of these were present, grouped around a central paler area; in others they were fewer and scattered; and in two elongated forms they were present as two deep-blue, spore-like bodies surrounded by paler areas, a little distance on each side from the centre. Sometimes, attached to the more pointed end by a delicate strand, was an almost isolated smaller mass.

MICROFILARIÆ IN THE BLOOD OF AUSTRALIAN BIRDS.

Dr. T. L. Bancroft,[5] in 1889, communicated a paper dealing with the occurrence of filarial embryos in the blood of the following birds from Queensland: —

Eurystomus pacificus, Lath. (in 9 out of 9 examined); *Strepera graculina*, White (in 1 examined); *Gymnorhina tibicen*, Lath. (in 3 out of 4); *Cracticus destructor*, Temm. (in 12 out of 23); *Chibia bracteata*, Gould (in 1 out of 4); *Myiagra rubecula*, Lath. (in 2 out of 4); *Sericulus chrysocephalus*, Lewin (in 3 out of 10); *Oriolus sagittarius*, Lath., syn. *Mimeta viridis*, Lath. (in 2 out of 5); *Corone australis*, Gould (in 2 examined); *Pomatorhinus frivolus*, Lath. (in 5 out of 14); *Myzantha garrula*, Lath. (in 15 out of 16); *Entomyza cyanotis*, Lath. (in 4 out of 10); *Anellobia chrysoptera*, Lath. (in 3 out of 4); *Trichoglossus novæ-hollandiæ*, Gmel. (in 3 out of 6); and *Podargus strigoides*, Lath. (in 2 examined). We have studied microfilariæ from three of these species, namely, *Gymnorhina tibicen*, *Corone australis*, and *Anellobia chrysoptera*.[6]

It may be pointed out that the bird referred to by Dr. Bancroft and one of us as *Anellobia lunulata* is really *A. chrysoptera*, Lath. (syn. *A. mellivora*, Lath.), as the former is only found in Western Australia.[7] The two species, however, very closely resemble each other.

Larval filariæ (Microfilaria sp.) in the Blood of the Black-backed Magpie or Piping Crow-shrike (*Gymnorhina tibicen*, Lath.).

In the blood of *Gymnorhina tibicen*, shot near Sydney in March, 1910, the presence of larval filariæ was noted. The parasites were short, with the anterior end blunt and rounded, the posterior narrowed slightly and also blunt. There was no sheath. The cuticle showed well-marked, delicate, transverse annulations. The body protoplasm stained a deep purple with Giemsa's solution, showing granular masses; one or two of these were isolated at the anterior end, a small clearer area surrounding them, and occupying the extreme anterior end of the parasite. Two, three, or four clear spaces

(5) Bancroft, T. L., Proc. Roy. Soc., Queensland, vi., 1889 (1890), pp. 58-62.

(6) Johnston, T. H., Jour. Proc. Roy. Soc., N.S.W., xliv., 1910, pp. 109, 111, 114.

(7) Matthews, E., "Handlist of the Birds of Australasia," in Emu, vii., 1908, Supplement, p. 99.

were noted in the protoplasm. The length was about 0·11 mm., and the maximum breadth 0·0045 mm.

In films taken from another bird shot near Berry, New South Wales, in August, 1910, a few microfilariæ were detected. These were much smaller than the above, being only 0·045 mm. long by 0·004 mm. broad. The anterior end was not appreciably narrowed, but appeared to be bluntly rounded, whilst the other end gradually narrowed to terminate in a pointed tail. The cuticle possessed fine annulations. The body stained deeply and uniformly.

Larval filariæ (Microfilaria sp.) in the Blood of the Raven *(Corone australis)*.

In blood-films from a raven, *Corone australis*, shot near Barraba, New South Wales, in December, 1909, and for which we are indebted to Mr. A. R. MacCulloch, were found larval filariæ of about 0·09 mm. in length, by 0·0038 mm. in breadth. Both ends of these were bluntly rounded, the posterior being narrowed slightly. There was no sheath. The cuticle possessed delicate annulations. The protoplasm was finely granular and stained a deep-blue.

Larval filariæ (Microfilaria sp.) in the Blood of the Brush Wattle-bird *(Anellobia chrysoptera*, Fam. *Meliphagidæ)*.

In July, 1907, Dr. T. L. Bancroft, of Brisbane, Queensland, was good enough to forward us blood-films from eleven specimens of *Anellobia chrysoptera*, shot near Brisbane, and accompanied this with a letter stating that in these films would be found apparently two species of filaria and a trypanosome. On examination we found that in four birds the two forms of filaria were present, in three only the larger, and in four none. Two of the birds harbouring both forms were also found to possess trypanosomes.

The two microfilariæ, which appear to us to belong to different species, have characters as follows:—

(1). Larger Form.—The parasites were relatively large, being from 0·16 mm. to 0·19 mm. long by 0·0045 mm. broad, with a blunt anterior end and a gradually finely-pointed posterior end. There was no sheath. The cuticle showed well-marked transverse striations. The body cells stained pale-blue with Giemsa, and were finely granular. The anterior end remained almost unstained, except for the presence of a few partly-isolated masses succeeded by a clear space. The V-spot was well

behind the head; there was a tail spot near the posterior end.

(2). Smaller Form.—The parasites were considerably shorter and smaller, being from 0·06 mm. to 0·09 mm. in length, by 0·0045 mm. in width. The anterior end was blunt; the posterior gradually slightly narrowed, and was also blunt. There was no sheath and no noticeable cuticular striation. The protoplasm of the body cells, stained with Giemsa, assumed a deep-purple tint, and was coarsely granular. There was a large, square, clear space at the junction of the posterior and middle thirds; the V-space (?) was a little in front of the centre.

The difference between the two forms after staining by Giemsa's method was very striking, the larger assuming a pale-blue colour, the smaller a deep purple.

LIST OF AUSTRALIAN BIRDS EXAMINED FOR HÆMATOZOA.

The following is a list of 139 Australian birds, belonging to 77 species, whose blood has been examined by us for hæmatozoa with negative results.

In addition to the name of each species we have appended its number in Matthew's "Handlist of the Birds of Australasia," published in "The Emu," vol. vii., 1908, supplement.

We desire to acknowledge the courtesy of Mr. A. J. North, of the Australian Museum, Sydney, who was good enough to identfy those specimens about which we were uncertain:—

List I.

30. *Lopholœmus antarcticus*, Hawkesbury River, November, 1909.
37. *Phaps chalcoptera*, Sydney, December, 1909.
125. *Sterna bergii* (3 specimens), Perth, W.A., January, 1909.
133. *Anous stolidus* (Noddy), Abrolhos Island, W.A., January, 1908.
137. *Larus novœ-hollandiœ*, Abrolhos Island, W.A., January, 1908.
149. *Zonifer tricolor* (2), Adelaide District, May, 1910.
151. *Charadrius dominicus*, Sydney, March, 1910.
157. *Ægialitis ruficapilla*, Perth, September, 1909.
158. *Ægialitis melanops* (2), Adelaide District, May, 1910.
161. *Himantopus leucocephalus*, Tailem Bend, S.A., May, 1909.
199. *Xenorhynchus asiaticus*, Lath., Sydney Zoo, August, 1910.

204. *Notophoyx novæ-hollandiæ*, Hawkesbury River, August, 1910.
237. *Phalacrocorax carbo*, Hawkesbury River, April, 1910.
258. *Astur fasciatus* (2), Sydney, March, 1910; Adelaide District, May, 1910.
267. *Haliastur sphenurus*, Adelaide District, May, 1910.
280. *Cerchneis cenchroides*, Bathurst, December, 1909.
307. *Glossopsittacus concinnus* (2), Berry, July, 1909.
308. *Glossopsittacus porphyrocephalus*, Adelaide District, May, 1910.
343. *Platycercus eximius* (2), Orange, July, 1909; Bowral, May, 1910.
354. *Psephotus hæmatorrhous*, Moree, October, 1909.
361. *Psephotus hæmatonotus* (2), Orange, July, 1909.
376. *Podargus strigoides*, South-East Queensland, July, 1910.
407. *Cacomantis flabelliformis* (2), Hawkesbury River, November, 1909; Berry, August, 1910.
412. *Chalcococcyx plagosus*, Perth, September, 1909.
429. *Hirundo neoxena*, Sydney, March, 1910.
433. *Micræca fascinans* (3), Sydney, April, 1909, March, 1910; Bowral, May, 1910.
438. *Petræca Leggei*, Adelaide District, May, 1910.
440. *Petræca phœnicea* (3), Adelaide District, May, 1910 (2); Bowral, May, 1910.
443. *Petræca rosea*, Hawkesbury River, June, 1909.
444. *Petræca Goodenovii* (2), Adelaide District, May, 1910; Tailem Bend, S.A., May, 1910.
446. *Petræca bicolor*, Adelaide District, May, 1910.
449. *Smicrornis brevirostris* (2), Tailem Bend, S.A., May, 1910.
459. *Pseudogerygone fusca*, Berry, July, 1910.
487. *Rhipidura tricolor* (3), Sydney, April, 1909 (2); June, 1909.
493. *Sisura inquieta*, Tailem Bend, S.A., May, 1910.
504. *Coracina robusta*, Berry, August, 1910.
526. *Psophodes crepitans*, Sydney, April, 1910.
557. *Origma rubricata* (2), Hawkesbury River, June, 1909.
568. *Acanthiza pyrrhopygia*, Tailem Bend, S.A., May, 1910.
569. *Acanthiza lineata* (4), Sydney, November, 1909, (2), August, 1910; Adelaide District, May, 1910.
574. *Acanthiza chrysorrhoa*, Berry, August, 1910.
575. *Acanthiza reguloides*, Bowral, May, 1910.
582. *Sericornis frontalis*, Sydney, April, 1910.
586. *Sericornis maculata*, Adelaide District, May, 1910.
593. *Malurus cyanochlamys* (4), Orange, July, 1909 (2); Adelaide District, May, 1910 (2).

602. *Malurus lamberti* (2), Hawkesbury River, September and October, 1909.
625. *Artamus superciliosus*, Bathurst, December, 1909.
634. *Artamus tenebrosus*, Sydney, March, 1910.
636. *Collyriocichla harmonica* (3), Sydney, March, 1909, June, 1910; Hawkesbury River, October, 1909.
646. *Grallina picata*, Sydney, June, 1909.
660. *Falcunculus frontatus*, Tamworth, October, 1909.
667. *Pachycephala pectoralis*, Hawkesbury River, June, 1909, February, 1910.
674. *Pachycephala rufiventris* (3), Tamworth, October, 1909; Hawkesbury River, October, 1909, November, 1909.
683. *Eopsaltria australis* (3), Sydney, May, 1909, August, 1909, August, 1910.
689. *Aphelocephala leucopsis*, Adelaide District, May, 1910
704. *Climacteris picumna* (4), Moree, October, 1909; Sydney, March, 1910; Adelaide District, May, 1910; Bowral, May, 1910.
705. *Climacteris scandens* (2), Sydney, March, 1909, April, 1909.
709. *Zosterops Gouldi*, Perth, September, 1909.
726. *Pardalotus punctatus* (2), Hawkesbury River, June, 1909.
741. *Melithreptus brevirostris* (4), Sydney, April, August, November, 1909, March, 1910.
752. *Acanthorhynchus tenuirostris* (2), Sydney, May, 1909; Hawkesbury River, February, 1910.
756. *Glycyphila melanops* (3), Sydney, April, November, 1909, April, 1910.
764. *Meliphaga phrygia*, Hawkesbury River, April, 1909.
770. *Ptilotis chrusotis* (4), Hawkesbury River, June, December, 1909 (2), April, 1910.
772. *Ptilotis sonora*, Adelaide District, May, 1910.
778. *Ptilotis leucotis* (5), Hawkesbury River, April, June, October, 1909; Sydney, March, 1909, March, 1910.
781. *Ptilotis melanops* (3), Hawkesbury River, April, 1909; Sydney, April, 1909, August 1910.
791. *Ptilotis penicillata*, Orange, July, 1909.
797. *Meliornis pyrrhoptera*, Adelaide District, May, 1910.
801. *Meliornis sericea* (4), Sydney, March, 1909 (2), March, July, 1910.
804. *Myzantha garrula*, Orange, July, 1909.
806. *Myzantha flavigula*, Moree, October, 1909.
810. *Anellobia chrysoptera* (2), Hawkesbury River, September, 1909; Sydney, March, 1910.
822. *Anthus australis*, Sydney, April, 1909.

838. *Ægintha temporalis* (7), Sydney, March, 1910, April, 1910 (2); Berry, August, 1910 (4).
850. *Oriolus sagittarius* (2), Hawkesbury River, April, 1909; Berry, August, 1910.
883. *Corcorax melanorhampus*, Berry, May, 1910.

List II.

The following is a list of eight birds belonging to five species introduced into Australia in all of which blood examinations for hæmatozoa were negative: —

Turtur suratensis (Indian dove), Sydney, November, 1909.

Sturnus vulgaris (common starling), (2), Sydney, April, 1909; Berry, May, 1909.

Fringilla chloris (greenfinch), Sydney, March, 1910.

Carduelis elegans (goldfinch), (3), Adelaide District, May, 1910.

Merula merula, Linn. (syn. *Turdus merula*), (blackbird), Adelaide, May, 1910.

List III.

List III. comprises those Australian species in some members of which we have detected hæmatozoa. It consists of thirteen species, represented by fifty-six specimens, twenty-two of which harboured blood parasites. In some specimens, *e.g.*, *Anellobia chrysoptera*, both filariæ and trypanosomes were present.

Halteridia were found by us in the following eleven species: —

227. *Nettium castaneum*, Broughton Island, N.S.W., 1907 (in 1 examined).
283. *Ninox boobook (?)* South-East Queensland, July, 1910 (in 1 examined).
490. *Myiagra nitida*, Hawkesbury River, November, 1909 (in 1 examined).
530. *Pomatorhinus superciliosus*, Hallett's Cove, near Adelaide, May, 1910 (in 1 examined); Tailem Bend, S.A., May, 1910 (2, *nil*).
544. *Oreocichla lunulata*, Bulli, N.S.W., April, 1909 (in 1 examined).
712. *Zosterops cærulescens*, Sydney, May, 1909, February, 1910 (in 1 out of 2), April, 1910 (in 1 out of 2), June, 1910 (4, *nil*), July, 1910 (2, *nil*), August, 1910 (2, *nil*); Adelaide, May, 1910 (2, *nil*).
733. *Melithreptus atricapillus*, Sydney, July, 1909 (in 1 out of 2).

775. *Ptilotis chrysops*, Hawkesbury River, April, 1909 (in 1 out of 2 examined); Sydney, July, 1909 (1, *nil*).
787. *Ptilotis plumula*, Perth, W.A., 1909 (in 1 examined).
799. *Meliornis novæ-hollandiæ*, Sydney, March, 1909 (in 1 out of 2), August, 1909 (1, *nil*), April, 1910 (1 *nil*), July, 1910 (1, *nil*), August, 1910 (2, *nil*).
818. *Tropidorhynchus corniculatus*, Hawkesbury River, April, 1909 (in 1 examined).

Trypanosomes were found in one species: —

810. *Anellobia chrysoptera*, Hawkesbury River, September, 1909 (1, *nil*); Sydney, March, 1910 (1, *nil*); South-East Queensland, July, 1910 (trypanosomes found in 2 out of 11 examined).

Microfilariæ were found in three species: —

647. *Gymnorhina tibicen*, Berry, May, 1909 (1, *nil*); Bowral, May, 1910 (2, *nil*); Sydney, March, 1910 (in 1 examined); Berry, August, 1910 (in 1 examined).
810. *Anellobia chrysoptera*, Hawkesbury River, September, 1909 (1, *nil*); Sydney, March, 1910 (1, *nil*); South-East Queensland, July, 1910 (in 7 out of 11 examined).
847. *Corone australis*, Barabba, N.S.W., December, 1909 (in 1 out of 2 examined).

List IV.

List IV. includes an introduced species, in two members of which we have found hæmatozoa (*Plasmodium passeris*, Johnston and Cleland): —

Passer domesticus (sparrow), Richmond, N.S.W., May, 1909 (1, *nil*); Sydney, May, 1909 (in 2 examined); Adelaide, May, 1910 (2, *nil*).

It will be seen from the above lists that of 195 Australian birds examined, representing ninety species, Halteridia were found in twelve birds belonging to eleven species. The percentage of infected hosts was thus about six. The percentage of species found to be infected was about twelve. Trypanosomes were found in two individuals belonging to one species, the infection being about 0·5 per cent. of the total number of specimens examined. In regard to microfilariæ, we found them in ten birds belonging to three species. Thus about 5 per cent. of the total number of birds examined were found to harbour filarial embryos. Bancroft [8] in 1889 examined 114 birds belonging to fifteen species harbouring

[8] Bancroft, T. L., Proc. Roy. Soc., Queensland, vi. (1889-1890), pp. 58-62.

microfilariæ in Queensland, and found sixty-seven to be infected, the percentage of infected birds in the species thus being nearly sixty. He did not give a list of those species in which microfilariæ were not found by him.

Amongst thirteen specimens of introduced birds belonging to six species, plasmodia were found in two birds belonging to one species.

ADDENDUM.

A paper entitled "Notes on Blood-parasites" by Gilruth, Sweet, and Dodd has recently appeared in Proc. Roy. Soc., Victoria, xxiii. (n.s.), pp. 231-241. A Plasmodium *(P. biziuræ*, n. sp.) is described from a musk duck *(Biziura lobata)* (pp. 231-4), and microfilariæ *(M. gymnorhinæ*, n. sp.) from a magpie *(Gymnorhina tibicen)* in Victoria (pp. 236-9). We have refrained from attaching names to the microfilariæ examined by us, as a name given to the larva becomes the correct specific name for the adult when found, and, moreover, it is not an easy matter to refer a particular larva to a particular adult. It seems to us that the different types of microfilariæ in one host may belong to different species of filariidæ, and the naming of all the embryos from one host under one name may thus lead to confusion.

DESCRIPTION OF PLATES.

Plate XXV.

All the figures have been drawn to the same scale.

Fig. 1. Normal erythrocyte of *Pomatorhinus superciliosus.*
,, 2- 5. Halteridium, sp., in red cells of *P. superciliosus.*
,, 6. Normal erythrocyte of *Melithreptus atricapillus.*
,, 7-10. Infected erythrocytes of *Melithreptus atricapillus.*
,, 11. Normal erythrocyte of *Zosterops cærulescens.*
,, 12-17. Infected erythrocytes of *Zosterops cærulescens.*
,, 18-20. Protozoa (?) from blood of *Zosterops cærulescens.*

Plate XXVI.

Fig. 1. Normal red cell of *Myiagra nitida.*
,, 2- 5. Infected red cell of *Myiagra nitida.*
,, 6, 11. *Trypanosoma anellobiæ*, from *Anellobia chrysoptera.*
,, 7. Normal erythrocyte of Owl.
,, 8-10. } Infected red cells of Owl.
,, 12-15. }
,, 16. Normal erythrocyte of *Ptilotis plumula.*
,, 17-22. Infected erythrocytes of *Ptilotis plumula.*